CLAIMS

What is claimed is:

1. A fuel cell comprising:

a dielectric substrate material having upper and lower surfaces;

a porous film disposed on said upper surface of said dielectric substrate material;

said porous film comprising at least one electrode; and

channels extending through said dielectric material from said upper surface to said lower surface.

2. The fuel cell of claim 1 additionally comprising a fuel source disposed in relation to apertures of channels on said lower surface of said dielectric material.

3. The fuel cell of claim 2 wherein said fuel source comprises at least one member selected from the group consisting of hydrogen gas, alcohols, O_2, and other compounds containing redox pairs.

4. The fuel cell of claim 3 wherein said oxygen source is ambient air.

5. The fuel cell of claim 1 wherein said porous film is etch-processed.

6. The fuel cell of claim 1 wherein said porous film comprises a solid electrolyte.

7. The fuel cell of claim 6 wherein said solid electrolyte comprises a proton exchange polymer.

8. The fuel cell of claim 7 wherein said proton exchange polymer comprises Nafion®.

9. The fuel cell of claim 8 additionally comprising a moisture cap.

10. The fuel cell of claim 7 wherein said solid electrolyte is disposed on said dielectric substrate by a method comprising spin coating, lamination, or spraying.

11. The fuel cell of claim 6 wherein said solid electrolyte comprises an oxide conducting electrolyte.

12. The fuel cell of claim 11 wherein said oxide conducting electrolyte comprises a zirconia-based electrolyte.

13. The fuel cell of claim 11 wherein a catalyst is disposed on said solid electrolyte and wherein said catalyst comprises a refractory material.

14. The fuel cell of claim 13 wherein said refractory material is selected from the group consisting of platinum, Ru, or a Pt-Ru alloy.

15. The fuel cell of claim 11 having operation temperatures between approximately 100°C and approximately 1000°C.

16. The fuel cell of claim 7 wherein said solid electrolyte comprises a high temperature proton-conducting electrolyte.

17. The fuel cell of claim 1 wherein said porous film comprises a silicon-based thin film membrane.

18. The fuel cell of claim 1 wherein said thin film membrane comprises at least one member selected from the group comprising silicon nitride and silicon carbide.

19. The fuel cell of claim 17 wherein said silicon-based thin film membrane comprises a low stress, pre-tensioned membrane.

20. The fuel cell of claim 17 wherein said silicon-based thin film membrane comprises a thickness between approximately 0.5 μm and approximately 20 μm.

21. The fuel cell of claim 20 wherein said silicon-based thin film membrane comprises a thickness between approximately 1μm and approximately 10 μm.

22. The fuel cell of claim 21 wherein said silicon-based thin film membrane comprises a thickness between approximately 1μm and approximately 5 μm.

23. The fuel cell of claim 22 wherein said silicon-based thin film membrane comprises a thickness of approximately 1μm.

24. The fuel cell of claim 17 wherein said silicon-based thin film additionally comprises a patterned and etched geometric array comprising an approximately 1μm diameter and an approximately 2 μm pitch.

25. The fuel cell of claim 24 wherein said silicon-based thin film membrane comprises a thickness of approximately 1 μm.

26. The fuel cell of claim 17 wherein said silicon-based thin film membrane is formed through low pressure chemical vapor deposition.

27. The fuel cell of claim 17 wherein pores are formed in said silicon-based thin film membrane through reactive ion etching.

28. The fuel cell of claim 17 wherein said thin film comprises a mask for an anodization etching process.

29. The fuel cell of claim 1 wherein said porous film comprises a conductive layer.

30. The fuel cell of claim 29 wherein said conductive layer comprises at least one material selected from the group consisting of gold, aluminum, platinum, other metals, metal alloys, and a conductive organic material.

31. The fuel cell of claim 29 wherein said conductive layer comprises at least one catalyst.

32. The fuel cell of claim 29 wherein said catalyst is disposed on said conductive layer to comprise a porous catalyst.

33. The fuel cell of claim 31 wherein said catalyst comprises a material selected from the group comprising platinum, ruthenium, and platinum-ruthenium alloys..

34. The fuel cell of claim 31 wherein said catalyst comprises a catalyst for high temperature operation comprised from a member of the group consisting of alloys of Noble metals, non-Noble metals, metal oxides, and oxide compositions.

35. The fuel cell of claim 34 wherein said Noble metals are selected from the group comprising Pt, Au, Ag, Pd, and Ag/Pd alloys.

36. The fuel cell of claim 34 wherein said non-Noble metals are selected from the group comprising Ni, Co, Cu, and Fe.

37. The fuel cell of claim 34 wherein said metal oxides are selected from the group comprising PrO_2, CeO_2, and InO_3.

38. The fuel cell of claim 34 wherein said oxide compositions are selected from the group comprising manganites and cobaltites.

39. The fuel cell of claim 31 wherein said conductive layer and said catalyst are disposed by at least one method selected from the group consisting of chemical vapor deposition, physical deposition, evaporation, and ink deposition.

40. The fuel cell of claim 1 wherein said at least one electrode comprises at least one anode and at least one cathode.

41. The fuel cell of claim 40 wherein said anode and said cathode comprise different surface areas.

42. The fuel cell of claim 41 wherein said surface area of said anode comprises between approximately two times and approximately ten times less surface area than said surface area of said cathode.

43. The fuel cell of claim 42 wherein said surface area of said anode comprises approximately four times less surface area than said surface area of said cathode.

44. The fuel cell of claim 43 wherein said surface area of said anode comprises a width of approximately 40 μm and a length of approximately 1 cm, and wherein said cathode comprises a width of approximately 160 μm and a length of approximately 1 cm.

45. The fuel cell of claim 40 wherein said at least one anode comprises a width of between approximately 10 μm and approximately 200 μm.

46. The fuel cell of claim 40 wherein said at least one cathode comprises a width of between approximately 10 μm and approximately 200 μm.

47. The fuel cell of claim 40 wherein said anodes and said cathodes are interposed in interdigitated planar relation.

48. The fuel cell of claim 47 wherein said anodes and said cathodes comprise a configuration selected from the group consisting of parallel, series, or combined parallel-series configurations.

49. The fuel cell of claim 40 wherein said at least one anode and said at least one cathode comprise serpentine or spiral patterns.

50. The fuel cell of claim 1 wherein said dielectric substrate comprises a silicon-based material.

51. The fuel cell of claim 50 wherein said dielectric substrate comprises silicon nitride.

52. The fuel cell of claim 1 wherein said channels are formed by joining at least two micromachined wafers.

53. The fuel cell of claim 1 wherein said channels comprise pores within said dielectric substrate.

54. The fuel cell of claim 53 wherein said dielectric material surrounding said channels comprises a dielectric barrier.

55. The fuel cell of claim 54 wherein every other said dielectric barrier between an anode and a cathode comprises a conductive layer coating.

56. The fuel cell of claim 54 wherein said dielectric barrier comprises a width between approximately 10 μm and approximately 50 μm.

57. The fuel cell of claim 56 wherein said dielectric barrier comprises a width of approximately 25 μm.

58. The fuel cell of claim 53 wherein said pores are formed by reactive ion etching.

59. The fuel cell of claim 53 wherein said pores comprise at least one flow path for providing fuel to said at least one electrode.

60. The fuel cell of claim 1 wherein an aperture of said channels corresponds approximately to surface areas of said electrode.

61. The fuel cell of claim 1 wherein said porous film comprises pores.

62. The fuel cell of claim 61 wherein said pores of said porous film have a diameter of between approximately 5 nm and approximately 1000 nm.

63. The fuel cell of claim 1 wherein surfaces within said cell comprise geometries selected from the group comprising planes, curved surfaces, flexible surfaces, and cylinders.

64. The fuel cell of claim 63 wherein apertures of said cylinders may comprise geometric figures selected from the group consisting of triangles, rectangles, circles, polygons, and ellipses.

65. A bipolar fuel cell comprised of two fuel cell units as in claim 1 wherein said upper surfaces of said units are in joined connected relation.

66. The bipolar fuel cell of claim 65 wherein only one of said two fuel cell units comprises a porous film.

67. The bipolar fuel cell of claim 65 wherein said at least one electrode of one of said units comprises an anode and said at least one electrode of remaining said unit comprises a cathode.

68. The fuel cell of claim 1 wherein said lower surface of said dielectric substrate material comprises a coating comprising an ohmic contact.

69. The fuel cell of claim 68 wherein said ohmic contact is comprised of a material selected from the group comprising aluminum, gold, silver, other metals, and metal alloys.

70. The fuel cell of claim 1 additionally comprising micro-switching devices.

71. The fuel cell of claim 70 wherein said micro-switching devices selectively interconnect said electrodes.

72. The fuel cell of claim 70 additionally comprising micro-switching devices within said channels for controlling a fuel flow.

73. The fuel cell of claim 1 additionally comprising cooling means for reducing a fuel cell temperature.

74. The fuel cell of claim 1 formed entirely by semiconductor manufacturing methods.

75. A fuel cell comprising an etch and anodization processed, porous electrode.

76. The fuel cell of claim 75 wherein said electrode is silicon-based and wherein said silicon is doped.

77. A process for making an electroprocessed, porous film, the process comprising the steps of:

providing a support substrate;

forming a film on the support substrate; and

etching pores in the film.

78. The process of claim 77 further comprising the step of etching the support substrate.

79. The process of claim 77 wherein the forming step comprises forming a film comprising at least one layer comprising at least one conducting layer and at least one dielectric layer.

80. A method of making a silicon-based electrode, the method comprising the steps of:

providing a silicon-based substrate;

etching at least one side of the silicon-based substrate; and

anodizing the etched silicon-based substrate thereby forming pores in the silicon-based substrate.

81. A method of embossing a substrate, the method comprising the steps of:

providing a support substrate;

forming a film on the support substrate;

patterning features of the film;

providing a second substrate; and

embossing features of the film into the second substrate.

82. The method of claim 81 wherein patterning comprises at least one step selected from the group consisting of adding material to the film and subtracting material from the film.

83. A method of making a mold, the method comprising the steps of:

providing a silicon substrate;

patterning the silicon substrate; and

contacting the silicon substrate with a deformable material thereby imparting the pattern to the deformable material.

84. The method of claim 83 wherein patterning comprises at least one step selected from the group consisting of adding material to the film and subtracting material from the film.

85. A method of lithography processing a substrate wafer, the method comprising the steps of front side processing the wafer and back side processing the wafer.

86. The method of claim 86 wherein front side processing comprises the steps of:

providing a clean wafer;

disposing a film on the wafer;

disposing a photoresist layer onto the film;

masking the photoresist layer with a geometric array;

exposing the masked photoresist layer;

developing the photoresist layer;

rinsing the photoresist layer; and

etching the layered wafer.

87. The method of claim 86 wherein the film disposing step comprises a process selected from the group consisting of chemical vapor deposition, physical deposition, and sputtering.

88. The method of claim 86 wherein the film is silicon carbide.

89. The method of claim 86 wherein the etching step comprises reactive ion etching.

90. The method of claim 85 wherein back side processing comprises the steps of:

providing a clean wafer;

disposing a photoresist layer on the wafer;

waiting at least approximately one hour;

masking the photoresist layer with a geometric array;

aligning the mask with the masking of the front side;

exposing the photoresist layer;

developing the photoresist layer;

rinsing the photoresist layer; and

etching the layered wafer.

91. The method of claim 90 wherein the film disposing step comprises sputtering and baking the wafer.

92. The method of claim 90 wherein the etching step comprises reactive ion etching.

93. The method of claim 92 wherein the reactive ion etching comprises alternate polymer deposition.

94. A packaging method comprising the steps of:

evaporating a small amount of gold;

depositing the gold onto a ceramic package; and

attaching an electrode to the ceramic package with a gold conductive epoxy.

95. A manufacturing process comprising the steps of providing a wafer and forming on the wafer at least two fuel cells as in claim 1.